Impacts of High Speed Railway Station on non-metropolitan Cities in China：

A Case Study of Wuhan-Guangzhou Line

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Abstract

High Speed Railways (HSR) is regarded as the main tool for achieving redistribution of population and economic activities in mainland China. With precedent success in many countries, the HSR are expected to have advantages of reducing transport cost and improving inter-city connection, which would provide great developing opportunities for cities have HSR station construction. However, many small and middle cities along HSR that planned station new town resulted in "ghost city", while the metropolitan central cities are becoming more and more crowded. That is to say, the economic impact of HSR is different on cities according to their developing degree. Because of the regional imbalance and disparity of market size between metropolitan central cities and periphery cities in China, population and economic activities would shift to larger market with reducing transportation cost by HSR.

This paper discusses economic impacts HSR on cities based on the empirical study of Wuhan-Guangzhou HSR. A prospective analysis investigating the case shows the differentiation in urban population and economic development related to developing degree of cities along HSR. Reminding the fact that not all cities could benefit from the HSR project, small and middle cities which connected to the metropolitan central cities are actually the most vulnerable group. Helping these authorities making right developing strategy for HSR.

Key Word: High Speed Railway. Inequality Market. Non-metropolitan Cities. Development Strategy.

Contents

1. Introduction

Large scale transport infrastructure that connecting metropolitan central city and peripheral cities[1] contributes to regional integration. Investment on these infrastructures encourages population flow and production exchange within the region (World Bank 2008). Historically, many great cities originated from transportation hub such as port, railway station, or airport. The increasing demand of good exchange now makes transport accessibility still be a quite crucial factor for concentration and distribution.

Originated in 1964, Japan, High Speed Rail (HSR) became popular in Europe in 1980s, many famous metropolitan areas achieve great agglomeration benefits because of this efficient ground inter-city transport. Tokyo and Kyoto's great development is one of the most illustrative examples showing that cities could gain a lot of development benefits due to the construction of HSR network which is called Shinkansen[2] in Japan. This success helps people confirming the potential development opportunities brought by inter-city transportation infrastructure like HSR.

China started building its own High Speed Railway (HSR) network in 2004. There are four horizontal lines and four vertical lines being planned crossing China's mainland. In 2008, the first HSR Line from Wuhan to Guangzhou was put into operation. In 2010 alone, the passenger volume reached 0.29 billion, which is the second largest passenger volume in the world, only after the Shinkansen in Japan. Believing in that HSR network has a positive effect

[1] Middle cities, small cities and county level cities, presented as non-metropolitan cities in this paper.

[2] Shinkansen is a network of high-speed railway lines in Japan operated in 1964by four Japan Railways Group companies. Starting with Tokyo, the network has expanded to currently consist of 1,625.3 mile of lines with maximum speeds of 240–320 km/h. It links most major cities on the islands of Honshu and Kyushu, with construction of a link to the northern island of Hokkaido underway.

on strengthening the inter-city connection, development opportunities are always expected in those connected cities.

The construction of HSR project can greatly reduce transporting time, providing convenient travel alternative between cities, creating new employment opportunities, what is the most important, balancing the regional developing degree. The net-effect HSR creates for the country and regional economy is also expected to have positive impacts on local economy development. In order to take advantage of these potential benefits, local authorities that have HSR stations are competing with investing HSR New Town in the station surrounding area, which is expected to be a new urban center that catalyzing the urban economy development. However, many people concern negative impacts HSR would bring to local economy. They argue that in regions where have particularly spatial disparities and asymmetric market sizes, the construction of transportation channel contributes to reduced transport cost from peripheral regions to metropolitan centers. As a result, the HSR in these regions would become a straw that takes population and economy activities away from non-metropolitan cities, rather than becoming urban catalyst to local economy. Actually, after 5 years operation of HSR, many of Station New Towns in non-metropolitan cities have turned to be ghost towns or sleep towns, leaving large amount of vacant housing units and office space, rather than forming new urban centers.

Initially, HSR is established as one of the greatest significantly measures for China's overland transportation system and regional development. Aiming at decentralizing population and economic activities from metropolitan central cities. However, middle and small cities outside the metropolitan central areas are the most vulnerable group because of

less attractive market, limited resource and irreversible developing process, it is of great significance to take a close examination of the actual impact they would have before encouraging the Station New Town movement.

The paper studies the population and economy facts of cities connected by HSR network in China based on the empirical study of Wuhan-Guangzhou HSR. Hypothesis is that the HSR project would have straw effect on small and middle cities it crosses over. Metropolitan cities gained great benefits from the HSR project, while the small and middle cities suffered loss of population and employment. For specific, this paper will compare the difference of growth rate between non-metropolitan cities with HSR and those without HSR project, to illustrate the negative impact by finding the correlation between constructions of HSR and the growth of employment rate. Also, the three metropolitan centers is under different degree of development, this study will also see whether there is activities flow between these metropolitan center cities.

The paper will start with introduction of the background of this problem. In Chapter 2, there is literature review for precedent study of this problem. Chapter 3 talks about the methodology of this study, including index selection, and model building. Data analysis is shown in Chapter 4. Chapter 5 draws the conclusion and recommendations of the whole paper. In the last part of this paper, future study is suggested. In a word, this paper is trying to figure out the different impacts it has on cities according to different developing degrees, helping local authorities to realize the developing fact and avoiding blind investment on station construction.

1.1 Background

China is booming at an extremely fast speed. In the past 30 years, the average increase of Gross Domestic Product (GDP) is about 10% per year. However, this fast development has great spatial disparity and inequity. As great cities like Beijing and Shanghai, the total amount of GDP is nearly $330 billion per year, which is almost 10 times greater than most of middle and small cities in Southeastern China, don't even say cities in the west of China where is on much lower development degree, as well as the urbanization process. Given the fact of this huge disparities of regional development, China's central government established a HSR network planning which main purposes are, according to the statement of the government, strengthening connection between cities, balancing developing speed by extending population and products flow and providing cheaper as well as environment friendly inter-city transit option (CPGPRC, 2005). The HSR network project is a national development policy expected to make contribution to driving the development of cities along the network. By building connection, this new transportation network will encourage diffusion of economic activities to middle and small cities from metropolitan central areas, regional development balance is expected to be achieved.

High Speed Railway (HSR) refers to railway trains with a speed above 250 km/h (UIC, 2014). With capacity of carrying a large amount of passengers, extremely high speed and relatively lower cost than air flight, nowadays HSR is becoming one of the most popular transport alternatives for inter-city travel in many countries. According to the International Union of Railways (UIC, 2014), 22,954 km HSR is under operation and 12,754 km is under construction all over the world. China's central government has an ambition of HSR project. So far, there are "four vertical and four horizontal" lines having been planned crossing

mainland of China, with a total number of 22,481km (Table 1), taking nearly a half of the world's total construction miles.

Table 1. The Distance of HSR Construction (km)

	In operation	Under construction	Long-term planning	Total
China	11132	7571	3777	22481
World	22954	12754	18841	54550

Source: High Speed Lines in the Worlds. Rep. International Union of Railways

The HSR network in China crosses 97 cities with 142 stations in planning. It will connect almost all cities with population more than 0.5 million in the southeast of China. Once completed, the network is expected to serve 90% of China's total population (UIC, 2014). Figure I shows the whole HSR network and its operation time, as well as the speed of each line. This huge transportation network took more than 0.29 billion passengers in 2013 alone, which made it the second largest HSR in the world, next to Shinkansen network in Japan.

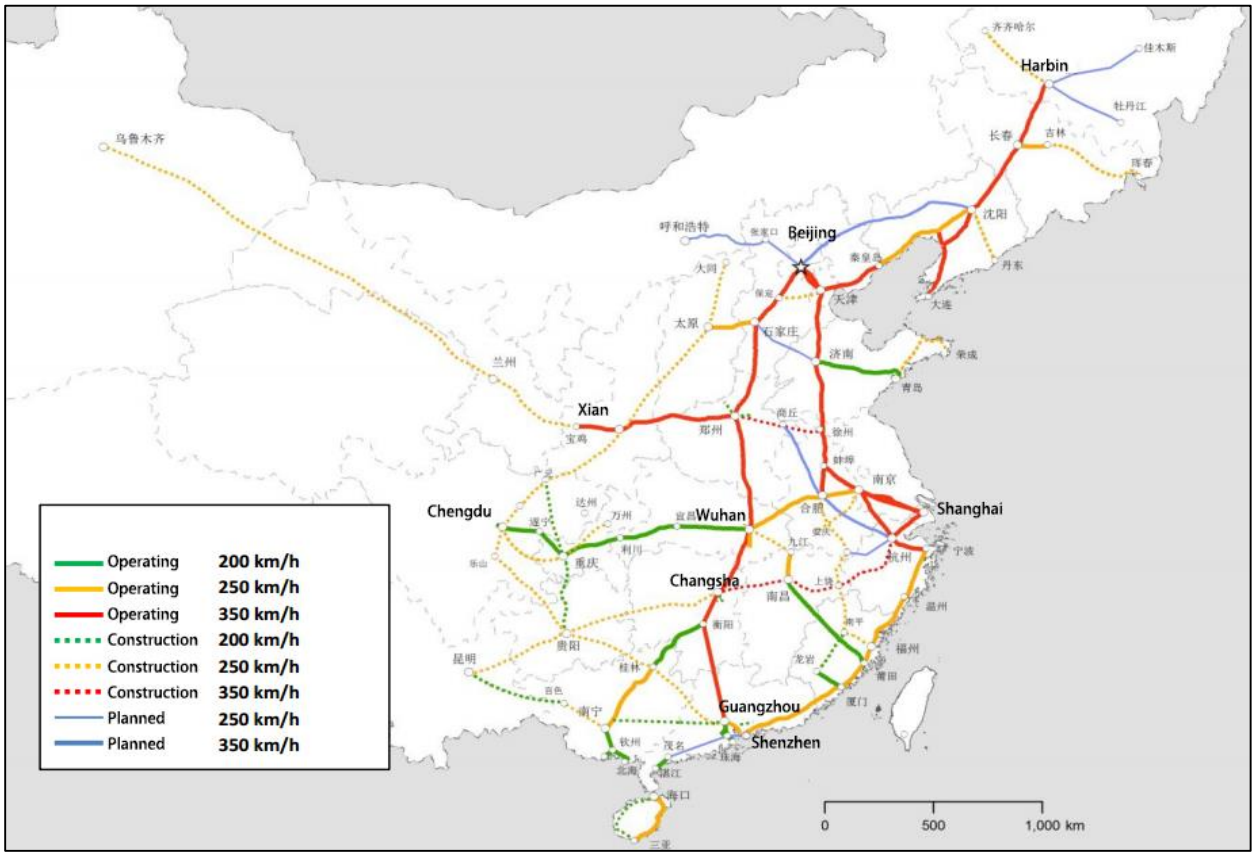

Figure 1. HSR System in China

Source: China Railway Corporation planning and Statistics Department, 2013. 12.

1.2 Practical Problem

Having conceived the ambitious desire that HSR stations would bring population flow and economic activities, rail oriented development is regarded as one of the most ideal investment strategies of taking advantage of HSR project. These areas are developed with visions of bringing better accessibility, improving related facilities, and changing of urban fabric to its surrounding area, even a whole city. According to the gross statistics of information from the public information, among 71 cities that have a HSR stations operating, more than 40 have planned or being planned to construct new districts surrounding HSR station. Dreaming of building another Shinjuku[3], The design of these new districts is aiming at attracting foreign firms that specialize in business and financial service, which have high production added value and property value. These cities are planning to develop a location for high-end properties that would compete with other modern locations, and building attractive urban sub-center. These rail oriented development is generally called Station Newtown (SNT). However, these SNTs are actually areas surrounding HSR station, where are initially suburban areas where far away from the traditional cities center with few current facility and industry foundation.

Though all of SNTs offering multi-family dwellings and a wide variety of high-quality amenities such as museums, hotels, hospitals, and shopping facilities. Few station meets people's high anticipation in practice. Many of these SNTs endowed with high expectations of being a new center of cities have already been observed phenomena of "ghost town" because of overestimating of population and economic activities (Bao, 2014). Those high

[3] District in Tokyo which gained great development because of building railway station comprehensive town.

density of residential and commercial buildings are left vacant and looks blight in the suburban landscape. On the contrary, central cities in metropolitan areas are becoming more and more crowded after the construction of HSR. This phenomenon suggests that the effect of the HSR network connection has different effects on cities, that is, it does bring great growth to metropolitan central areas but this benefit is not equally brought to small and middle cities. The actual impact of HSR should be evaluated from a regional level perspective, rather than the effect to a single city.

However, small cities governments seem to be too shortsighted to see the potential side effect. When people spend less time cost to commute between cities with help of advanced transport system, as well as freight, the construction of HSR may lead to a shift of labor force, and economic activities from less developed cities to metropolitan areas, rather than bring the same benefit to all cities in the region. Things are getting worse, in 2014 alone, 29 new HSR towns are planned, mostly located on small cities or peripheral areas. More "Ghost Towns" will be created if the misunderstanding of transportation catalyst cannot be fully understood.

1.3 Research Content and Significance

It must be treated with caution for large scale transportation infrastructure like HSR, since the opportunity is rare, especially for small and middle cities. However, these non-metropolitan cities are also vulnerable groups in the development process because of their limited competitive resource. Now planning Station New Town is the single development strategy for many cities without consideration of the straw effect due to the dominant power from metropolitan central cities. In the five years' operation of HSR, numerous capital was

invested to develop the stations surrounding areas. There are plenty of qualitative analyses advocating the positive impact of HSR, while few study show the effect with quantitative data.

This paper studies the empirical economic impact on the cities along HSR, quantifying to clarify the exact impact of the HSR on the region, especially on small and middle cities which have more vulnerable markets. Illustrating the actual population and economic activities flow before and after the construction of HSR. Also, this paper clarifies the different impacts the HSR has on metropolitan cities and non-metropolitan cities. In addition, the paper tries to recommend correlated developing strategies for non-metropolitan cities to help these prefectures making wise investment in the decision-making process regarding railway station area vitalization. For regional development, having an insight knowledge of HSR will help to avoid interregional homogeneous competition, and leading to developing an integrated region. Moreover, with knowledge of impact of HSR on its crossing cities, further planning of HSR network would be better-designed.

2. Literature Review

Literature review of this study focuses on two issues: 1) The related theory of impact of HSR on its connected cities 2) The existing empirical study review of HSR on its located cities. The first part is theory retrospection and the second part is empirical study model building and outcomes summary, including both international and domestic ones.

2.1 Theoretical Foundation

2.1.1 Studies on Regional Economic Growth

Date back to the origin of city, transportation has had a great significance on urban development. It connects origins and destinations and touching everywhere of cities, forming the bone of urban with affecting the conjunct areas both economically and socially. Theory with respect to impacts of interregional transportation infrastructure and its connected cities are numerous and very important for urban study.

The fact that transportation brings economic activities to cities has been proved by scholars in 20 century (Fogel, 1964. Kenneth, 1992), they promoted that the dynamic movement encouraged by transportation generates population flow, good exchange, capital flow and information flow that all contribute to urban development and regional activation. Even though some scholars challenged the advantage of transportation because there is no need for face-to-face communication with the development of information technology, Glaeser (1998) affirmed the transportation advantage by promoting the City Agglomeration Theory and emphasized the necessary of real world transportation. In 2012, Glaeser reaffirmed his idea by empirical study of several cities, proving that development of

transportation contributes to economy agglomeration. This advantage presents with growth of market input and output, labor force and creative industry. He successfully showed that for metropolitan areas, transportation improvement benefits products concentration, while ignored the effect of this connection to periphery cities.

In the view of New Economic Geography Theory (Krugman, 1991), transport cost is one of the most crucial factors impacting the international and inter-regional trade. With the reduction of transport cost, industry and economic activities turn to concentrate in regional dominant area. Krugman applied the *Core-Periphery Theory* shows when a region is integrally connected, there would be concentration toward the region central area, and then has an effect of distribution after the central area is saturated. Krugman's theory describes two different processes that transportation infrastructure has on cities, these different processes can also be applied to HSR cases, which implies that the non-metropolitan cities may experience the loss of economic activities before the saturation of central cities. However, few empirical study of theory is done with the developing countries, and the criteria of the saturation of areas may vary.

2.1.2 Studies on impact of HSR on Local Economy

The theory of urban catalysts (Wayne, Donn, 1989) was promoted to explain urban development or renewal strategies comprised of a series of projects that driving and guiding urban development on local level. It provides opportunities for a cities to optimize its transportation system, readjust land use and concentrate urban center, improve livability, as well as bringing population and economic activities. It initially described urban design project and then applied widely, including a variety of projects that have a positive

externality that benefits urban revitalization. Some scholars regarded HSR station construction as such an urban catalyst.

In 1994, Cervero, R raised Rail Oriented Development (ROD) to illustrate the development in California, USA, made ROD become a particular term to describe development along railway stations. However, successful ROD development cases are almost located in great cities with high concentration of business and service industry so far. Few study shows that in non-metropolitan cities ROD could also be well conducted.

In general, theories tends to claim that the transportation has a positive impact on urban development and regional integration, as well as common sense.

2.2 Empirical Study

2.1.1 Impact of Inter-regional transport infrastructure

Empirical study of impact of inter-city transport network on its connected cities has been conducted for decades. William Hughes (1969) studied the effects of five roads constructed in rural areas in Malaya in the early 1960's, by conducting survey in villages along those roads, he illustrated five social benefits which a road, in conjunction with other investment, provided opportunity to a relatively isolated village because of improving quality of housing, educational opportunities, newspaper readership, medical care, marketing opportunities and availability of other amenities. These benefits were evaluated by people's respond to questionnaire, proving the social benefits transportation brings to an area, while did not include the economic development and balance in that region.

Sands (1993) reviewed the development effects of the Shinkansen's Tokaido line in early 1990s. He applied shift share analysis to study the employment of various industries. And found that cities and regions along Shinkansen experienced higher employment and population growth rate than areas not along the line. Particularly more growth in information exchange industries (business services, banking services, real estate), as well as higher education. This study found the base for many cities' development strategy that it is of great advantage to develop such industries around HSR station. However, in Sands's study, only industries that he thought would be impacted by the Shinkansen project were analyzed, instead of general economic development. His conclusion was challenged by many scholars.

Cervero and Bernick (1996) also examined the redistributive effects of Shinkansen on urban activities. Their analysis showed that thirty years after the services began, the Shinkansen failed to induce significant employment and population shifts to intermediate cities between Tokyo and Osaka. They concluded that the economic roles of intermediate cities, like Nagoya and Kyoto, within the nation's urban structure had been weakened by the project. Actually, in 1989, Eiji Ohno had applied the example of population distribution change surrounding Shinkansen and proved that the inter-city transport infrastructure does have problems concerning nationwide disequilibrium. He used labor distribution model predicted the economic outputs and employment along Shinkansen. Comparing the shift of labor force in construction, manufacture, transportation and communication, wholesale and retail, finance and service, he found that the labor in these industries increased greatly in Tokyo and Osaka metropolitan area, while weaker cities, like Nagoya, did not see growth. The project caused more concentration of population and industry in central Japan, rather

than decentralization. This paper studied the labor age structure in each industry while it did not test how much it is related to the Shinkansen project.

After Korea had constructed the HSR that connect nine regions, Lee et al. (2004) analyzed the influence of HSR on the distribution of regional population through the Spatial Model, and found effects of population inflow in HSR passing areas, whereas other regions had high possibility of population outflow. And then he applied Straw Effect to HSR connected cities: areas with HSR would see a drop of economic output compared to areas without HSR.

Kanbur (2005) also provided a micro conclusion that market size is a determinant of resource distribution, and that declining trade costs between large and small markets can strengthen the concentration of production in the larger market. More recently, Benjamin(2014) provided empirical evidence that large scale transport infrastructure can lead to a reduction in industrial and total output among connected peripheral regions compared to non-connected ones, rather than diffusing economic activities from metropolitan areas to the small market by analyzing China's National Trunk Highway System. He applied regression model by applying factors including GDP, Government Revenue, Population and Labor Mobility and analyzed cities within 50km buffer of highway. He found that even though the population had not changed much in these cities, periphery cities saw a declination of economic output and government revenue.

These studies remind us that although there are numerous of theories shows the positive effect of inter-city transport network has on urban economic development, side effects should also be taken into serious consideration as the empirical study shows. There is great possibility for cities connected by the transportation infrastructure that do not have core

comparative power resulting in potential diffusion of economic activities. That is easily happened in small and middle cities when they are connected to metropolitan areas which have absolutely larger markets, the falling trade cost between them could reinforce the concentration of production in the larger market.

2.2.2 Domestic Study of High Speed Railway Construction in China

Several studies have been conducted on China's High Speed Railway. Zhang (2009) predicted the impact of Beijing-Shanghai HSR on its surrounding cities. He applied studies of Shinkansen to assume that the construction of HSR would have an impact on service industry. Based on the location quotient analysis, she concluded several cities that have advantage in service industry and predicted that these cities along Beijing-Shanghai HSR would have a concentration of service industry once the HSR is put into operation in 2012. Since the Beijing – Shanghai HSR had not been operated when the study was conducted, it is difficult to testify whether the prediction is fair because there is difference between cities in China and Japan. In addition, her study only shows potential growth in cities have advantage in servers industry, impact on small cities that do not have such advantage cannot be evaluated.

The World Bank published a report analyzing the impact of Beijing- Shanghai HSR on its located cities in 2014. It provided predicted model to calculate the benefit and cost of HSR, analyzed the concentration economic effect and did interview to more than 45 companies along the HSR to quantify the impact on employment. Then combine these three aspects of data to explain the HSR' impact on regional economy. The result shows that HSR do have a positive impact on tourist industry in cities that are famous for places of interest. These study applied comprehensive model and specific interview data, while it also conducted before the

construction of HSR, the actual effect of HSR cannot be tell. Several researches were conducted to study the impact of HSR on tourist economy (Huang, 2011) with existing data. After two years construction of Wuhan-Guangzhou HSR, these studies applied existing data for showing the growth of tourists in Wuhan and Guangzhou from 2009 to 2011. While they only provide data in metropolitan central cities like Wuhan and Guangzhou. Again, small cities are ignored in these studies.

Ye (2011) firstly focused on the impact of HSR on small cities, she pointed out that small cities have weak power in decision making process for HSR station. Therefore, the construction of HSR station often disturbs there original urban form. Small cities governments are forced to make new master plan if they want to take advantage of the transportation hub. However, the lack of related facility and service making development of station new town in these cities slow. She set Changxing, Zhengjiang as an example to illustrate such challenge small cities face with constructing station new town. Her Study emphasized on physical urban form, rather than economic and social influence.

This paper will try to make up the missing part the HSR study, the impact of the HSR on the economic development of middle and small cities to clarify the regional effect of HSR and provide illustrator for development strategies.

3. Methodology

To verify the hypothesis that the HSR may result in a negative impact on non-metropolitan cities in China, methodology of this paper including two parts: population growth and economic activities change. Population growth is studied by comparing the change of compound population growth rate in cities have HSR and cities do not have. Economic activities are studies by calculating how much the construction of HSR impacts the change of compound annual employment growth rate before and after constructing the HSR project. The former one is descriptive quantitative analysis and the later one is conducted by regression model.

3.1 Index Selection

In previous studies of assessing the impact of transportation project, population growth rate and employment growth rate impacted are two prevalent indexes. To be more comprehensive, this paper choses change of population growth rate as the indication of HSR impact on population distribution. In China, people always flows across cities. So population in this paper used resident population, including permanent resident population with citizenship and floating population in certain cities. For economic activities, factors impact regional economy the most are economic output and employment in China. In former research such as Shinkansen studies in Japan and HSR studies in Korea, employment was set as the indicator of economic activities, because it shows the labor force's preference for a city. So this paper also selects employment as dependent variable that presents economic activities. Whether there is HSR station construction is a dummy independent variable that

expected to affect the employment. According to China's domestic study of other factors that independently impact employment (Yang, 2012), Growth Domestic Product (GDP), population amount, income were chosen as other three independent variables. Even though there were studies in western countries used human capital and education level as factors for employment, these data for each city is unavailable in China. Since the HSR's impact is different between metropolitan central cities and non-metropolitan cities, another independent variable is the city developing degree. Therefore, indexes in this study are population, employment and available factors that impact employment.

3.2 Sample Selection

The unit of this research is individual city. Since impacts of HSR line on cities 'economy would be analyzed by quantitative method, enough dataset is required. There are 8 lines of HSR established by Chinese government, among those 6 have been operated. Since effects may hard to be evaluated in a short time, the study in this paper targets on Wuhan-Guangzhou Line, China's first HSR line operated in 2009, to assess the differences took place in cities it goes through after its five years' operation.

Compared with road network which has influences in almost all cities it goes through, HSR line may merely affect cities where have stations constructed since the station spacing is quite far and people can only exit and enter at the station. Wuhan-Guangzhou HSR Line goes across three province, Hubei, Hunan and Guangzhou. In China, the political boundary of province may impact the development strategy more than the distance from the HSR. So the sample cities were select by province boundary, rather than the fixed distance from the HSR

line. There are 15 cities within 3 provinces along Wuhan-Guangzhou HSR Line that having station construction, and 35 cities that in the three provinces contain the HSR line but do not have station. These 50 cities would be sample to be studied. These 15 cities having stations are Metropolitan Central Cities-Wuhan, Changsha, Guangzhou, Shenzhen; non-metropolitan Cities- Xiangning, Yueyang, Zhuzhou, Hengyang, Chenzhou, Shaoguan, Qingyuan, Chibi, Miluo, Leiyang and Yingde, according to the city developing degree and location.

3.3 Research Design

China is experiencing a fast economy growth, almost all cities saw dramatic growth in last two decades. Therefore, this paper applies the difference of compound annual growth ratio before and after construction of HSR project indicator. It includes descriptive statistics for population share change and linear regression for employment compound annual growth rate analysis.

Step one, comparison of population change in cities before and after the HSR project. According to the Compound Annual Growth Rate (CAGR) formula, the compound annual growth rate could be got with:

$$CAGR\ (t_0, t_n) = (P\ (t_n)/P\ (t_0))^{1/(t_n - t_0)} - 1$$

t_0 = Initial Year, t_n = Last Year

Difference of Population Compound Annual Growth Rate (PCAGR) between 2005-2009 and 2009-2013 is used in analysis. The formula is as follow:

$$PCAGR_{2005\text{-}2009} = (P_{2009}/P_{2005})^{1/4} - 1 \quad (1)$$

$$PCAGR_{2009\text{-}2013} = (P_{2013}/P_{2009})^{1/4} - 1 \quad (2)$$

P_{2005}, P_{2009}, P_{2013} = Population in 2005, 2009, 2013.

The change of PCAGR before and after construction of HSR project is the difference between (2) and (1). Comparing the difference between metropolitan central cities with HSR, non-metropolitan cities with HSR and non-metropolitan cities without HSR could generate a general idea of population growth in this region.

In considering of that there is an overall growth of population all over the country during that time period, single ratio of population in these cities on the population in the whole country is calculated, which could tell a story about how population changes in these cities compared to the situation in the country.

Step two, the economic activities impact analysis: employment which represents economic activities of cities would be the dependent variable. The sample is 50 cities within the three provinces Wuhan-Guangzhou HSR passes by. Firstly, descriptive statistics would be applied to study the change of employment share cities have after building HSR project. Secondly, the relationship between HSR project and employment compound growth rate increase in 11 non-metropolitan cities would be studied by linear regression. Control samples are the 35 cities that have none station. Difference of Employment Compound Annual Growth Rate of (η) before and after constructing HSR project is the dependent variable, and there are four independent variables which are whether there is a HSR Station(X_1), difference of GDP Compound Annual Growth Rate(X_2), difference of PCAGR (X_3), Difference of Income

Compound Annual Growth Ratio(X_4), In addition, the city developing degree is also selected as factor to be studied, so it is the last independent variable(X_5), the regression model is:

$$\eta = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \varepsilon \quad (3)$$

in which,

x_1 = HSR (cities with HSR = 1, cities without HSR = 0);

x_2 = Change of GDP Compound Annual Growth Rate

= $((GDP_{2013}/GDP_{2009})^{1/4} - 1) - ((GDP_{2009}/GDP_{2005})^{1/4} - 1)$;

x_3 = Change of Population Compound Annual Growth Rate = (2) – (1);

x_4 = Change of Income Compound Annual Growth Ratio

= $((Income_{2013}/Income_{2009})^{1/4} - 1) - ((Income_{2009}/Income_{2005})^{1/4} - 1)$;

x_5: City Developing Degree

Metropolitan Cities = 1, Non-Metropolitan Cities= 2, 3, 4, 5 according to city scale[4]

β_1, β_2, β_3, β_4, β_5, ε : Constant.

The data analysis will be processed in Stata. These coefficients tell correlation between the dependent variable and independent variables. And the P value of this model tells whether the factor is statistically significant for prediction in this model.

[4] The developing degree is evaluated by China CBNWeekly, they applied 10 indicators, including the luxury brands density and amount, GDP, per capita income, 211 colleges and universities, Global Top 500 company amount, airport's passenger throughput, the number of embassies and consulates, the number of international airline routes. Details see Appendix D.

These analyses would show how the employment changed in the region related to the operation of the HSR, and further demonstrate the impact of HSR has on population as well as economic activities redistribution in metropolitan central cities and non-metropolitan cities.

3.4 Data Sources and Data Collection

Data used in these analyses would be second hand data derived from:

- Local Statistics Report form city government official website;
- China City Statistical Yearbook 2004-2013 from National Bureau of Statistics of the People's Republic of China;
- China City Boundary Shape file from China Architecture and Urban Planning Department ;
- China Railway Transport Yearbook2008-2013, China Railway Corporation planning and Statistics Department；
- China High Speed Railway Information from National Railway Administration of the People's Republic of China and International Union of Railway.

3.5 Assumptions of the Study

Firstly, the study assumes that the situation other than select indexes is almost the same to each city, or it at least not significantly impacts the development fact. Secondly, the sample size is large enough for regression analysis of regional economy development. At last, due to

China's fast development, the impact of HSR on population and economic activities could be seen by four years' data (2009-2013).

3.6 Limitations of the Study

Since the HSR was established on 2009, the impact on economy may not be evaluated by four years' data. Therefore, the accuracy of result might not be enough. Moreover, the economic activities is comprehensive, which is more than employment, and factors impact it are more than indexes selected in this study. Furthermore, the impact of social capital is also quite important for urban development, but the data was not easily access to, so this paper did not include the social aspect. In addition, there would not include structure of passengers of HSR, which may make the population flow by HSR less persuasive.

4. Data Analysis and Research Findings

4.1 Cities along the Wuhan-Guangzhou Line

Before 1978 China's open up policy, Chinese cities were almost under-developed. The central government established development strategy that sets cities along east coast as development priority, which results in an extremely uneven development of the whole country. Yangtze River Delta and Pearl River Delta, as well as Beijing-Tianjin metropolitan area benefits the most from this spatial oriented development policy, fruits in taking the most of economic output. The policy changes now in order to balance the regional development, inner land is look forward developing opportunities. With an intention of decentralizing the industry in Pearl River Delta and driving the development of inner land, Wuhan-Guangzhou HSR is constructed. Cities along this HSR are showed in Table 2:

Table 2. Cities along Wuhan-Guangzhou Line, 2013

Categories	Cities with HSR	Population (10thousand)	Administration Level
Mega City	Guangzhou	1292.68	Vice Provincial City
	Shenzhen	1062.89	Vice Provincial City
	Wuhan	1022.00	Vice Provincial City
	Changsha	722.14	Vice Provincial City
Non-MTA	Zhuzhou	110.82	Prefecture level city
	Hengyang	608.51	Prefecture level city
	Leiyang	116.49	County-level city
	Yueyang	493.68	Prefecture level city
	Miluo	62.22	County-level city
	Chenzhou	466.53	Prefecture level city
	Yingde	112.00	County-level city
	Qingyuan	379.11	Prefecture level city
	Xianning	248.50	Prefecture level city
	Chibi	48.30	County-level city
	Shaoguan	289.27	Prefecture level city

Data Source: China Statistic Yearbook 2013.

Note: According to administrative divisions in China, vice provincial city is the central city of a province, prefecture level city is the sub-division of a province, and county level city is subdivision of urban fringe of prefecture level city.

There are 15 cities in total along Wuhan-Guangzhou HSR that having station constructed. Among these four cities are metropolitan central cities: Guangzhou and Shenzhen are central cities of Pearl River Delta, Wuhan is central city of Wuhan metropolitan area, and Changsha is central city of Chang-Zhu-Tan metropolitan area. Guangzhou and Shenzhen are central cities of Pearl River Delta. Pearl River Delta is a relative mature metropolitan area having formed for years, while Wuhan metropolitan area and Chang-Zhu-Tan Metropolitan Area are new city agglomeration areas that established by China's central government's top-down plan. These two areas are still under organization and their urban systems are still lack of integration, though they are emphasized greatly in China's metropolitan development strategy 2030.

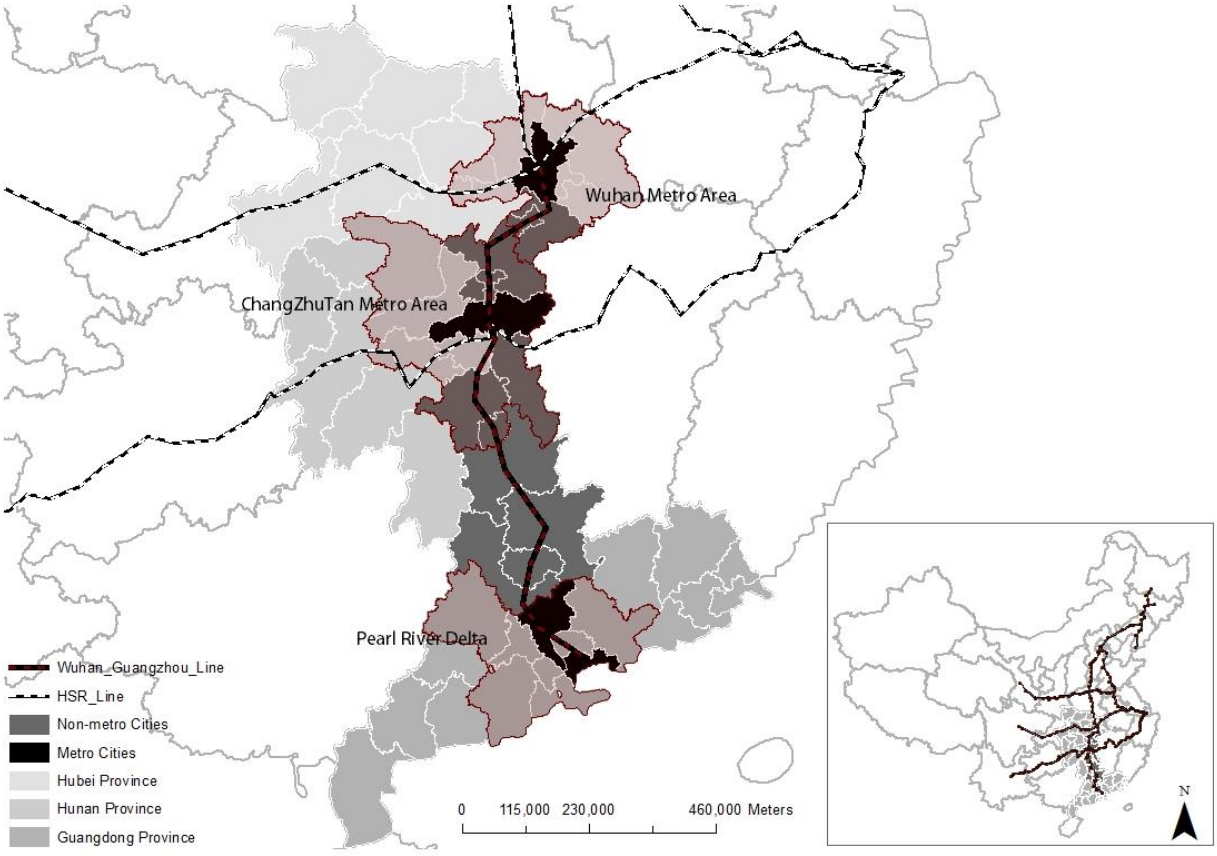

Figure 2. Cities and Metropolitan areas along Wuhan-Guangzhou HSR
Data Source: Shape file is from China Architecture and Planning Department, made by Author with ArcGIS

4.2 Population Shift

4.2.1 Data Analysis

Population shift after construction is one of the impacts of HSR on cities this paper analyzes. The Wuhan-Guangzhou HSR has been operated since 2009, a population distribution before and after constructing this project is showed in Table 3. In 2005, four years before the project being operated, the regional share of total population of the country is 5.44%, this percentage includes all cities in Guangdong, Hunan and Hubei provinces (these three province is defined as region in this study). The proportion changed to 5.30% in 2013, four years after operation of the HSR project, having a 0.14% declination of the national population share. For specific cities, metropolitan central cities all saw increasing rate of population share, both on region and on country. While the situation is totally different for the non-metropolitan cities, nine out of eleven of these non-metropolitan cities suffered a declination of regional population share during the 8 year time period. The city suffered the greatest declination, Zhuzhou, is just adjacent to Changsha, it is oriented as the secondary growth core of the Chang-Zhu-Tan metropolitan area. In the metropolitan planning vision, Zhuzhou will develop manufacture industry decentralized from Changsha. The HSR project is the main transportation tool to encourage this decentralization process of the region. However, the population in Zhuzhou experienced a great declination after the project, instead of absorbing population flowing into the city, which means that the HSR failed to play a role for taking population to Zhuzhou. Other non-metropolitan cities saw the same dilemma in the change of population share.

Table 3. Population Regional Share Change after HSR (2005 and 2013)

		2005		2013		Difference	
	City	**Region**	**Country**	**Region**	**Country**	**Region**	**Country**
	Guangzhou	14.66%	0.80%	17.92%	0.95%	3.26%	0.15%
Metro	Shenzhen	12.78%	0.70%	14.73%	0.78%	1.95%	0.09%
-cities	Wuhan	13.17%	0.72%	14.17%	0.75%	1.00%	0.03%
	Changsha	9.79%	0.53%	10.01%	0.53%	0.22%	0.00%
	Zhuzhou	5.58%	0.30%	1.54%	0.08%	-4.05%	-0.22%
	Hengyang	10.25%	0.56%	10.05%	0.53%	-0.20%	-0.02%
	Leiyang	1.73%	0.09%	1.61%	0.09%	-0.11%	-0.01%
	Yueyang	7.82%	0.43%	7.71%	0.41%	-0.12%	-0.02%
Non-	Miluo	1.11%	0.06%	0.86%	0.05%	-0.24%	-0.01%
Metro	Chenzhou	6.66%	0.36%	6.47%	0.34%	-0.19%	-0.02%
-cities	Yingde	1.45%	0.08%	1.55%	0.08%	0.10%	0.00%
	Qingyuan	5.55%	0.30%	5.26%	0.28%	-0.29%	-0.02%
	Xianning	4.27%	0.23%	3.44%	0.18%	-0.83%	-0.05%
	Chibi	0.66%	0.04%	0.67%	0.04%	0.01%	0.00%
	Shaoguan	4.51%	0.25%	4.01%	0.21%	-0.50%	-0.03%
	Region/Country	**5.44%**		**5.30%**		**-0.14%**	

Data Source: China Statistic Yearbook 2005, 2013.

Note: Region in this table refers to three provinces that Wuhan-Guangzhou Line goes through, which is Hubei Province, Hunan Province and Guangzhou Province; Country refers to total population in China.

In addition, the result of region population share of the country shows that the regional population share declined 0.14% from 2005 to 2013. In a word, in Metropolitan Cities, there is an increase of regional and national population, while in Non-metropolitan Cities, the population share decreased after constructing the HSR.

In case that these cities experienced population declination before 2009, rather than declination after the construction of HSR, the difference of Population Compound Annual

Growth Rate (PCAGR) between 2005-2009 and 2009-2013 is calculated, result is showed in Table 4.

Table 4. Comparison of Population Growth Rate (2005-2009, 2009-2013)

	4 years before opening	4 years after opening	Comparison
Category	**PCAGR 2005-2009**	**PCAGR 2009-2013**	**PCAGR DIFF**
Metro Cities	0.0324	2.0420	2.0096
Non-Metro	0.0112	0.0457	0.0345
Non-HSR	0.0081	0.7183	0.7102

Data Source: China Statistic Yearbook 2005, 2009, 2013.
Note: Metro Cities is metropolitan central cities, Non-Metro is non-metropolitan cities having HSR station, and Non-HSR is non-metropolitan cities within the region but do not have HSR station.

This result tells three things, firstly, metropolitan cities got the greatest population annual growth rate, 200.96%, after constructing the HSR. Secondly, non-metropolitan cities connected to these metropolitan central areas had the lowest growth rate, 3.45%, which only takes 1.7% of the growth rate that metropolitan cities achieved. At last, for non-metropolitan cities that do not have HSR station construction, the annual growth rate is 71.83% during 2009 to 2013, which is 71.02% larger than it was during 2005 to 2009. Therefore, the increase of population in non-metropolitan cities is larger than it in non-metropolitan cities that have HSR construction. And the rate in metropolitan cities reach a much higher growth.

4.2.2 Findings

Obviously, metropolitan central cities benefited more population bonus from the HSR project. The construction of HSR did have different impacts on population growth in different cities according to the city scale. HSR project failed to bring expected population to non-metropolitan cities, but took more population to central cities with the transportation accessibility. Moreover, HSR project failed to give non-metropolitan cities advantages for

absorbing population compared to their counterpart, which got a much higher population growth. In conclusion, evidence of change of population share shows that the HSR project failed to achieve its initial goal of population dispersion within the region. And it actually strengthens the agglomeration to central cities, rather than decentralized their population pressure.

4.3 Economic Impact

The change of industrial and market location and economic output would change the labor force in cities along HSR line (World Bank, 2014). Since flow of labor force shows exchange of economic activities between cities, it is an important indicator to illustrate the economy development impact HSR has on cities.

4.3.1 Labor Force Average Annual Employment Growth Rate Comparison

Though many theories emphasize the transportation benefit HSR would bring to cities having station construction, which contributes to reasonable growth of population and economic activities, it did not happen in HSR in China. Actually, Metropolitan Cities and Non-metropolitan Cities experienced different changes after the HSR project being put into operation.

Table 5 shows employment compound annual growth rate change comparison between four years before and four years after the operation of HSR in all cities along Wuhan-Guangzhou HSR. It also included average data for cities do not have HSR station but locate in the study region. In Metropolitan Cities, the average of compound annual growth rate increases during time period 2005-2009 to period 2009-2013 is 4.17%, but this increase in Non-metropolitan Cities having HSR stations is only 0.03%. It is clear that Metropolitan Cities gained much more employment growth after the HSR operation than Non-metropolitan ones. Someone may argue that Non-metropolitan Cities might develop slower than Metropolitan Cities during those year. However, the same employment growth in Non-

metropolitan Cities within study region but do not have HSR station construction reaches 6.98%, which means that Non-metropolitan Cities did have a potential capacity of growth, even more than the Metropolitan Cities. Therefore, Metropolitan Cities with stronger market magnet do have a straw effect to labor force in Non-metropolitan cities with the help of HSR project.

Table 5. Comparison of Employment Growth Rate Change after HSR (2005 to 2013)

		2005-2009	2009-2013	Growth	Avg
Metro-cities	Guangzhou	2.92%	13.41%	10.49%	4.17%
	Shenzhen	6.53%	9.25%	2.72%	
	Wuhan	4.19%	3.12%	-1.06%	
Non-Metro-cities	Changsha	5.95%	10.48%	4.54%	0.03%
	Zhuzhou	0.99%	10.57%	9.57%	
	Hengyang	0.43%	9.42%	8.98%	
	Leiyang	6.78%	1.32%	-5.46%	
	Yueyang	5.92%	6.82%	0.90%	
	Miluo	6.95%	3.00%	-3.95%	
	Chenzhou	2.01%	9.42%	7.41%	
	Yingde	4.86%	6.65%	1.79%	
	Qingyuan	3.64%	1.05%	-2.59%	
	Xianning	11.37%	-7.22%	-18.59%	
	Chibi	4.18%	2.03%	-2.14%	
	Shaoguan	2.59%	7.02%	4.43%	
Cities without HSR	Average	1.02%	7.99%	6.98%	6.98%

Data Source: China Statistic Yearbook 2005, 2009, 2013.

Moreover, there is employment outflow in Metropolitan Cities. Cities in Wuhan metropolitan area all saw a declination of employment. The central city, Wuhan, suffered a 1.06% loss of employment growth rate after HSR operation, while Guangzhou gained an increase of 10.49%. Wuhan is the center of Wuhan metropolitan center which was established by Chinese Central Government as metropolitan area in 2007. Guangzhou is the

center of Pearl River Delta, which has been a mature metropolitan area for many years. Guangzhou's regional dominant power is much stronger than Wuhan. Wuhan-Guangzhou HSR connects these two metropolitan areas, with an aim to drive the development of Wuhan metropolitan area. It takes only 3 hours from Wuhan to Guangzhou by HSR, instead of 10 hours by traditional railway. This convenience provides people in Wuhan easier access to larger market in Guangzhou, which explain the result Wuhan suffered a declination. Therefore, the straw effect not only impacts non-metropolitan cities, but impacts the weaker metropolitan central city.

4.3.2 Correlation Analysis

To study if the HSR project is related to the declination of employment growth in Non-metropolitan Cities, further statistics is applied. Multi-regression model is built for studying five factors may have impacts on the change of employment compound annual growth rate. 46 non-metropolitan cities are included as samples in employment growth rate analysis, among which 11 have HSR station construction. Conducted with Stata 10.0, the correlationship between compound annual growth rate of employment and construction of HSR, compound annual growth rate of GDP, compound annual growth rate of population, compound annual growth rate of Income, and City developing degree is analyzed. The result is as follow (Table 6):

Table 6. Regression Result of Employment Growth Rate in Cities along HSR (2005-2013)

Source	SS	df	MS	Number of obs	46
				F(5, 40)	4.89
Model	0.1265	5	.0253	Prob > F	0.0014
Residual	0.2071	40	.0052	R-squared	0.3791
				Adj R-squared	0.3015
Total	0.3337	45	.0074	Root MSE	0.0719

Employment	Coef.	Std. Err.	t	P>t	95% Conf.	Interval
HSR	-0.0704	.0269	-2.61	0.013	-0.1249	-0.0159
GDP	0.1011	.0776	1.30	0.200	-0.0558	0.2579
Population	-0.0237	.2634	-0.09	0.929	-0.5561	0.5086
Income	-0.4951	.2089	-2.37	0.023	-0.9173	-0.0729
City Level	-0.0238	.0110	-2.16	0.037	-0.0460	-0.0015
cons	0.1617	.0413	3.91	0	0.0781	0.2451

Data Source: China Statistic Yearbook 2005, 2009, 2013.

The model is drew as:

$$\eta = -0.08 \, x_1 + 0.10 \, x_2 - 0.02 \, x_3 - 0.50 \, x_4 - 0.02 \, x_5 + 0.16$$

The result shows that the dummy variable of HSR project was found to have negative value. Having a coefficient of -0.0754, the construction of HSR station in a certain city would have an almost 8% negative impact on its employment average annual growth rate. The Non-metropolitan cities with HSR station operation since 2009 was found to have negative influence on their employment growth rate compared to regions without HSR. This is a contradicting result from the general expectation that construction of a large transportation infrastructure will result in economic ripple effect in the area and contribute to more economic actives. What is more, when the city developing degree drops one unit, the

employment compound annual growth rate would drop 2.3%. Cities with high developing degree gain more employment growth. The less developed, the more vulnerable the city it is in this project. Construction of HSR and less developing degree both have negative impacts on employment growth rate in Non-metropolitan cities.

4.3.3 Findings

As concluded from the statistics result, Metropolitan cities benefits more employment growth from HSR than Non-metropolitan cities. Non-metropolitan cities without HSR station gain more employment growth than cities have. The transportation advantage HSR brings to cities is not equal.

What is more, Non-metropolitan cities constructed HSR station saw a declination of employment growth rate. The HSR project in Non-metropolitan cities has negative impact on its employment growth, which is out of expectation for those local authorities looking forward to building new urban economic center surrounding the stations.

At last, the employment growth would decline with the lower city developing degree, which means that whether a city could take advantage of the HSR is decided by its market size. The HSR project did not bring same developing opportunity to every city.

Therefore, the HSR project did not bring so many economic activities as it was expected. For Non-metropolitan cities which is really vulnerable group in these project, its limited developing opportunity would be absorbed to larger market because of the easier connection. This fact makes local government have to rethink their developing strategy around HSR station.

4.4 Summary

The chapter used descriptive statistics and regression model to analyze the actual impacts made through the construction of HSR in 50 cities by comparing the change of population and employment growth in cities with and without the HSR construction, as well as before and after the construction of HSR. Based on this, it identifies the impact of regional impact of this large-scale transportation infrastructure project, and the summarized analysis results are as follows:

Firstly, the result from observing the change in population of cities with HSR shows that the regional population share to the country became 0.14% lower after the 4 years since the HSR construction than 4 years before. That is to say, the HSR failed to bring population growth to this region. However, among all the 15 cities that got HSR station construction, the four metropolitan central cities achieved increasing population share in both regional and national. In the eleven Non-metropolitan cities, only Yingde city got an increase of regional population share, while other ten all suffered declination of regional and national population share.

The second finding which is interesting is the difference of compound growth rate between 2009-2013 and 2005-2009 for 50 cities within the study region. Metropolitan Cities with HSR station, Non-metropolitan Cities with HSR station and Non-metropolitan Cities do not have HSR all saw an increase of population growth rate. However, the Metropolitan Cities with HSR station got the highest growth rate, while the Non-metropolitan Cities with HSR got the lowest, much lower than the Non-metropolitan Cities without HSR station.

Thirdly, there was a flow of employment from weaker metropolitan city to stronger metropolitan city. Actually, in the case of Shinkansen in Japan, Nagoya's went through a reduction of economy after being channeled to Tokyo and Osaka metropolitan area (Sasaki et al, 1997), while the population and economic flow more activated in Tokyo and Osaka. The same phenomenon also happened in metropolitan cities along Wuhan-Guangzhou.

Therefore, the HSR project did have different impacts on different cities in term of the city developing degree. Metropolitan Cities got not only an increase of population share, but the largest growth rate after constructing the HSR. So there is a positive impact the HSR project has on these mega cities. But for Non-metropolitan cities having HSR, the impact is tend to be negative on both the population growth and the regional share.

These findings are against to what these middle and small authorities expected. They are looking for benefits from the channel effect taken by HSR. Believing in the neoclassical economic growth theory that the HSR station drives the importance of capital accumulation and population growth. However, in China's HSR project, the accumulation of population growth emerged intensively on the metropolitan central areas, rather than on all local authorities that have stations. The data analysis outcome of this chapter responds the hypothesis that the HSR have a negative impact on non-metropolitan cities. With this research outcome, one can no longer infer that there would be population inflow to the corresponding areas other than Metropolitan Central Cities with the construction of HSR. The determined factor for attracting population is the market size, instead of single factor of transportation infrastructure construction.

5. Conclusion and Strategy Inventory

According to the mainstream theory and Chinese domestic study, cities connected to HSR are going to see great growth opportunities because of the population flow and the exchange of economic activities. But the empirical study in this paper suggests that they bear further examination.

5.1 Negative Impact on Non-metropolitan Cities

It is true that the population growth may not be equal to the market demand growth, and the simply population fact is not as comprehensive as proving the adverse effect of HSR construction on the economic activities. But economic activities are generated by population flow, population growth rate showed some hints of the straw effect for economy as well. In the employment compound study, the regression analysis shows the actual impact of the HSR project on the employment growth rate, which illustrates five impacts.

The first impact is for cities have HSR station, Metropolitan cities gained more employment growth than Non-metropolitan Cities, and Non-metropolitan Cities which have no HSR station gained the largest growth after four years operation of the HSR. Neither the population nor the employment demand grew after the operation of HSR in Non-metropolitan Cities. Moreover, the growth of them is slower than cities with the same development degree. It can be inferred that this loss of growth is absorbed by the larger market in Metropolitan Cities.

Secondly, Non-metropolitan Cities without HSR station got the highest growth rate increasing, which indicates that there is a potential employment market in these middle and

small cities, the growth could be achieved in development environment without large inter-city transportation infrastructure.

Thirdly, there is a flow between metropolitan central cities with respect to the developing degree of metropolitan. Employment in Wuhan declined while Guangzhou increased after the reduced travel time between these two cities. These connection push more labor in Wuhan flow to Guangzhou, where got large market size. Therefore, the straw effect is not only exists in small cities, but exists the weaker metropolitan.

The fourth conclusion is drawn from the regression analysis which proves that there is a statistically significant relationship between the construction of HSR and the change of employment growth rate. By running analysis for 46 Non-metropolitan Cities, the result shows that the HSR has a negative 8% impact on employment growth rate. That is to say, the employment of the corresponding areas was testified to have been negatively influenced after the construction of HSR than before and compared to other cities do not have HSR, which presented an absolutely opposite result than the expected effect caused by transportation infrastructure investment.

At last, the city development degree also has negative impact on the employment rate. In other word, when the city developing degree drops, the employment growth rate would decrease. Accordingly, not only the HSR have a negative impact on Non-metropolitan Cities, but the cities in a lower developing degree suffered more declination. Referring to table 4, it can be found that the four county level cities (Miluo, Leiyang, Chibi, Yingde) tended to suffer decrease of employment rate growth, which means that the weak market is more vulnerable.

These findings shows that the projection from the optimistic scholars who support Railway Orientation Development are not totally wrong. At least in Metropolitan Cities, there is population growth as well as employment increment after construction of the HSR. However, it is the truth for only Metropolitan Cities. In fact, this fact fits their study very well. Because in either their theory or empirical study, only Metropolitan Cities are emphasized. If we review the successful cases of railway development, all cities gained great benefit are great cities, or at least regional dominant market. For instance, many cities are pursuing the developing legend like Tokyo by Shinkansen with ignoring that Tokyo is the absolutely dominant city in Japan even without the Shinkansen project. That is why construction of Shinkansen provided opportunities for more population and economic activities to Tokyo. It has the attractive force, so people go there.

In a word, the transportation infrastructure is only the tool by which people make use of, rather than the guarantee of development. The market comes first, and then the population and economic activities.

5.2 Implication to HSR Oriented Development

It seems that HSR has not achieved its goal for resource decentralization and redistribution in China. This temporary failure could be attributed to several developing problems prevalent in HSR surrounding cities. The immature metropolitan system, the homogenous competition, and the lack of accessibility to facility in most small and middle cities.

5.2.1 Immature Metropolitan System and Homogenous Competition

"Around half of the 10 mega-regions are either dominated by a single major center, or by a limited number of major centers which are located closely to one another."(Quart, 2014). It is true that the metropolitan areas in China now are almost dominated by a single mega-city and only a limited number have exhibited a significant level of polycentric. Other cities in the same metropolitan area have no advantage to compete with the central city both on market size and specific industry.

Moreover, most of these central cities are not so well developed themselves to decentralize industry. They are also seeking for opportunities for gathering resource to develop themselves. In other word, these mega-cities and mega-regions aren't being built with an eye toward maximizing the regional overall advantages and minimizing the downsides to other cities. The side effect on weak cities is not taken consideration in the metropolitan area plan. Most importantly, few small and middle cities have found their own dominant industry or developing orientation in the region, which makes them became subsidiary of mega-city. It is hard to form regional cooperation within the metropolitan region. As a result, many cities which are surrounded by concentric circles became bedroom communities for commuters that makes traffic jam and pollution even worse in central cities. So the metropolitan are in China is a process of polarity, rather than regional balancing.

Here is the answer why employment growth declined in non-metropolitan cities along Wuhan-Guangzhou HSR line. Because these cities do not have industry specialization, when they are connected to the larger market which is the single growth core of the region, it is reasonable that the population and employment will be absorbed away. To make thing

worse, most of these cities who have planning for building station new town are planning to create a financial and business center, rather than looking for their own advantages in the region. According to the empirical study, only mega cities that have a foundation of bank and service industry are successful by creating a new CBD around the station. In a region with single growth core, even there is resource distribution and industry decentralization, redistribution would never be the finance and service industry which earn the highest benefit to the central cities. It is true that having a growth pole is a necessary step in the development of metropolitan areas. However, a single core is just an urban area with one center, but to increase growth and productivity cities eventually need to encompass more, complimentary centers. The regional integration should be about industry specialization and corporation. Only when all cities find their own irreplaceable role in a region, the metropolitan area will be mature and the HSR project will play its expected roles.

5.2.2 Gap between Vision and Practice

As mentioned above, these vulnerable non-metropolitan cities are all regard building SNTs as their best development strategy. In fact, if Core-Periphery Theory is applied to the HSR case, the commercial and finance activities would unavoidably flow to metropolitan area. So building the new urban finance and service center around the HSR station is never a good developing strategy for all small and middle cities without such industry magnet.

Constructing high-end of commercial and residential real estate is a common economic strategy to achieve property-led development. Because these land uses are of great added value. However, this development strategy is more suitable for Global City (Power, 2005). Transferring the cities' industry from manufactory to service dominance needs a long

process. For small and middle cities which are almost blue-collar production center, it is hard to converse industry by a single transportation hub construction. The gap between the proposed industry in these planned SNTs and the practice situation of cities are so large.

5.2.3 Lack of Accessibility

Another reason for the HSR project' ineffectiveness is that the accessibility is usually on a low level in non-metropolitan cities in China, so it is difficult for these cities to develop along a new core with little connection to anywhere else in the city.

In many developed countries, the process of decentralization went along with the transformation of industry. Facilitates update came along with the construction of suburban. In addition, because of the pollution and industry slums, there was national urban decay during 18th century. As a result, people had willingness to flight from the urban area to the suburban, which makes the suburban rapidly growth. While in China, the process reversed. The urban area takes most of developing resource and investment, while the suburban area are still in a very low level of development. When there is a new town built in the suburban, the only attractive point is the lower rent, which makes these SNTs inevitably became sleep town or ghost towns.

In order to offset the strong magnet power form the metropolitan area as well as take advantage of the improvement of the transportation facility, Nakamura and Ueda (1989) concluded that the small cities who saw increasing because of High Railway Station all have completed inside urban transit and high level of accessibility, as well as local characteristics industry. For small cities that are planning constructing Station New town, these experience should be taken into consideration. A single inter-city transportation infrastructure may be

not helpful for the development of the city, but the related inside urban transit touching it may be.

5.3 Suggestion for Future Development

Since the result shows that middle and small cities which do not have advantageous market are planning to develop high-end commercial and financial new districts based on the HSR station. Findings of these paper make us have to clarify the practical problems HSR oriented development are facing and rethink about the developing strategies about HSR project. Because for cities do not have special industries and improved facilities, it is difficult for it to take the advantage of HSR project.

Cities are differently influenced by the HSR, building a new business center is not a wise development strategy for every city, especially considering phenomena of ghost town in several existing HSR Station New Towns. Concluding the different development strategy may be helpful to investment decision making for HSR in mainland China. The potential cases could be studied are cities along Shinkansen in Japan. Japanese Shinkansen is the earliest HSR in the world, which shared the largest amount of passengers in Japan. Investments on the station construction are mostly based on the regional tourist attractions for specific cities, such as active volcano, hot spring, and castle, including nature and history. These characters are special for each city and become their main competitive advantage in making use of the transportation connection. In France and Italy, HSR is also regarded as service innovations, while instead of building business center, there are several cases of real estate investments on temporary office space for mobile business people in Europe, which was very welcomed

by people travel by HSR since it provides necessity to them in travel. In addition, HSR in Taiwan often sees a market of agriculture products which reflects local characteristics and it has become one of its most attractive characters for each small cities. Therefore, there are alternatives for investment instead of building CBD around all Stations without considering the situation of individual city. The key point of these strategies are taking the special industry specialization for the individual and seeking for its advantage. Avoiding homogenous competition, especially when the industry is not its outstanding one.

6. Future Research

The paper draws a conclusion that HSR project construction does not have positive impact on non-metropolitan cities' population and economy activity growth. According to the analysis, in a short term, the paper found that HSR network leads to regional concentration from relatively undeveloped cities to metropolitan cities. Therefore, building HSR did not assuage the problem of excessive agglomeration and regional unbalance in Chinese cities, but exaggerated it, since the population and labor force went faster to metropolitan central cities after the HSR construction. The degree of concentration in central cities was much increased after the network was implemented.

However, the data is not available for 'long-run' effect analysis now, so the long-term impact of HSR concerning production capability into account would be future study. The HSR do encourage the improvement of infrastructure, so whether it can result in a decentralization needs more efforts and smart development strategy.

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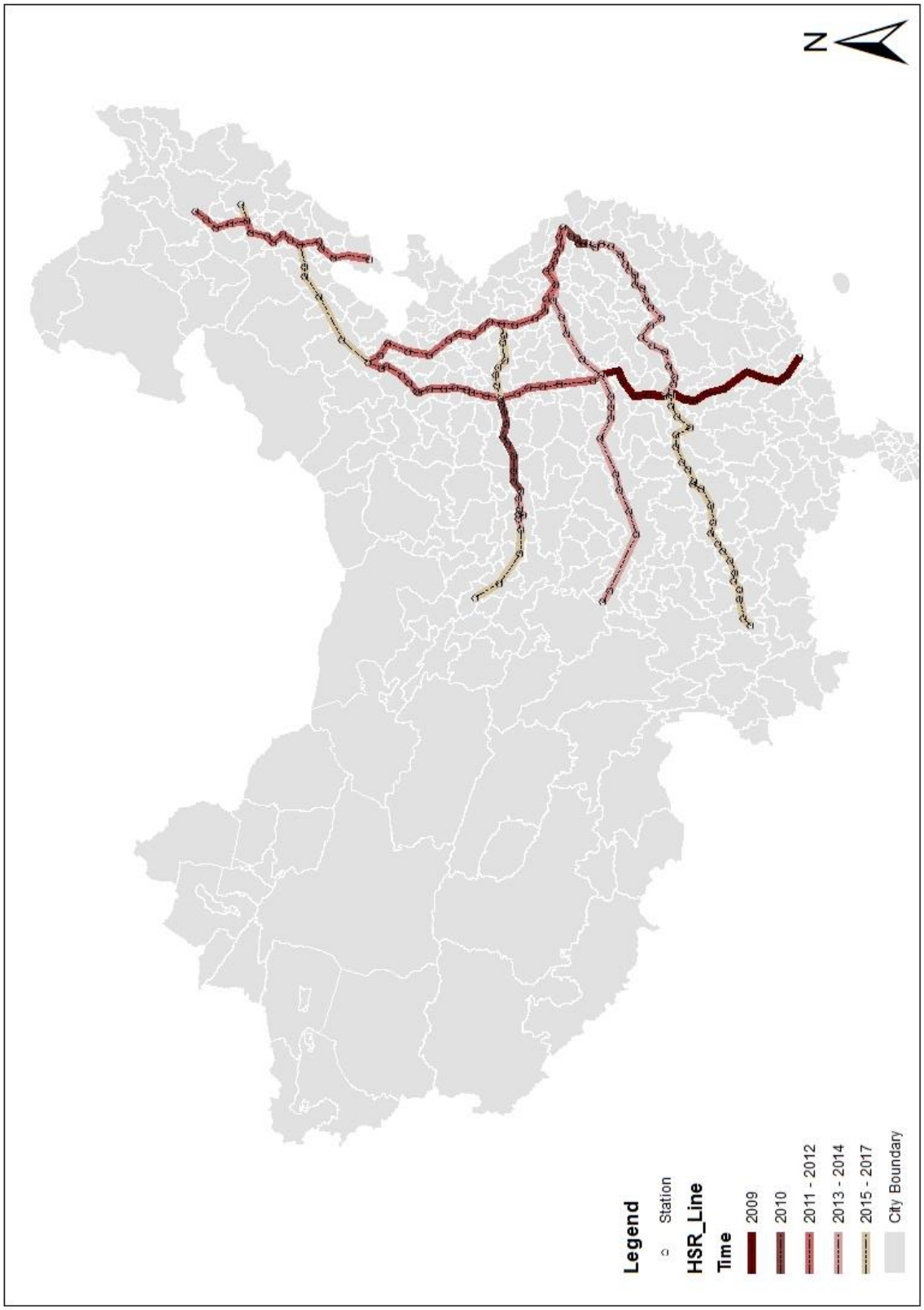
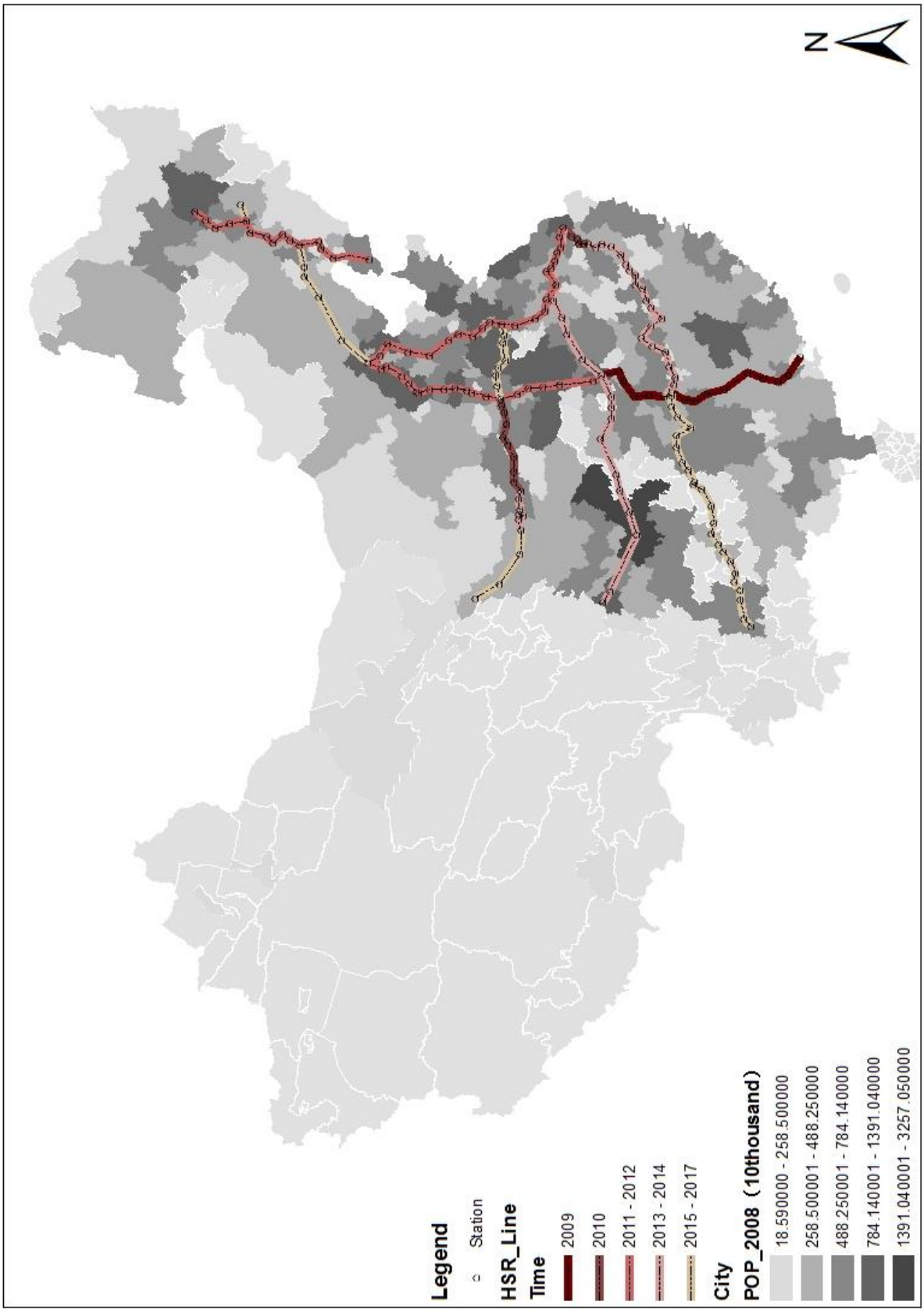
8. Appendix

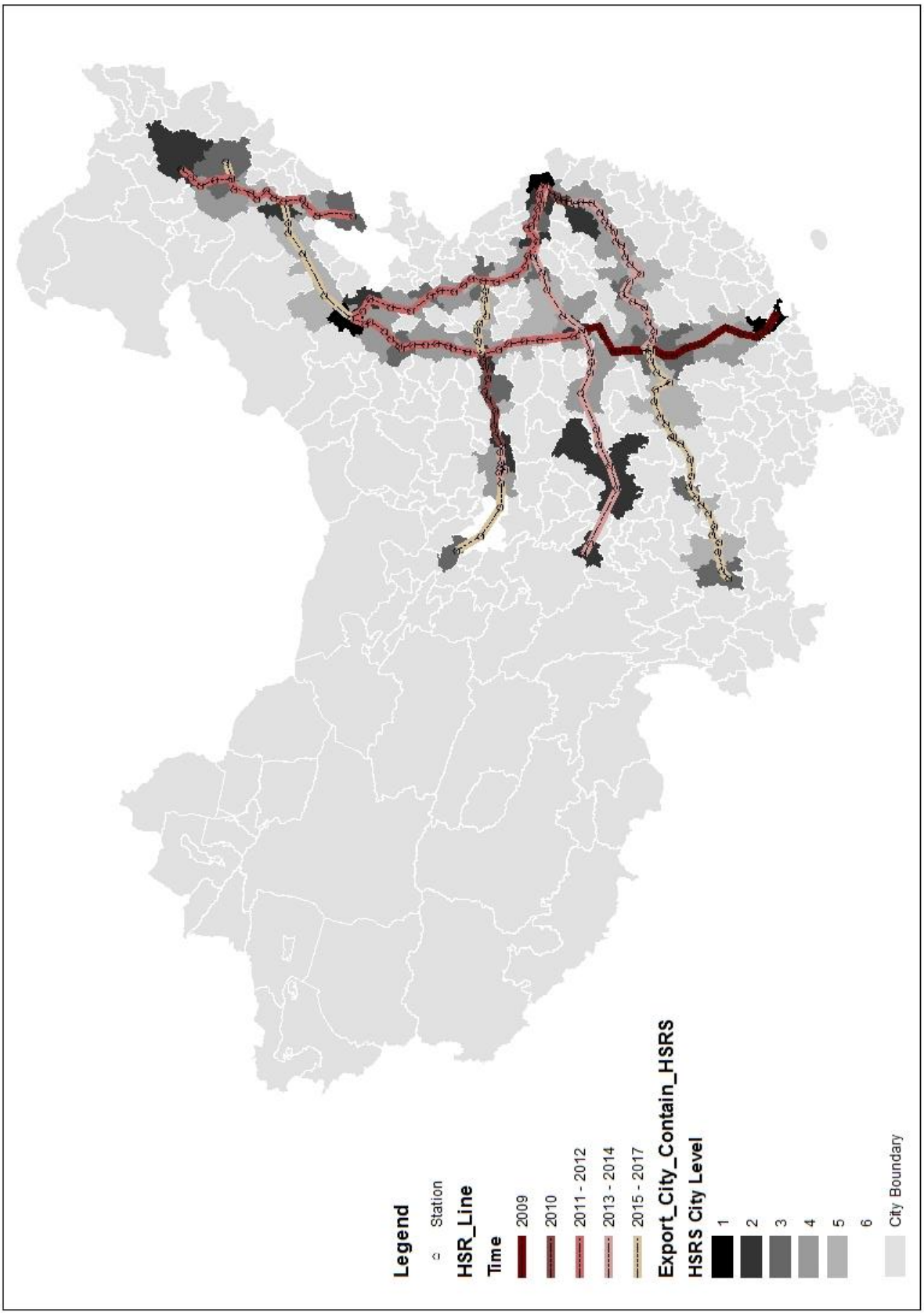
Appendix A： the HSR Network and Construction Time in China



Appendix B： the HSR Network Population Coverage in China



Appendix C： the Developing Degree of Cities HSR Network Covered in China



Appendix D： the Developing Degree of Cities HSR Network Covered in China

City	Developing Degree	City	Developing Degree
Guangzhou	1	Xiangtan	3
Shenzhen	1	Shaoyang	4
Wuhan	1	Changde	3
Changsha	1	Zhangjiajie	5
Zhuzhou	2	Yiyang	4
Hengyang	2	Yongzhou	4
Leiyang	5	Huaihua	4
Yueyang	3	Loudi	4
Miluo	5	Zhuhai	2
Chenzhou	3	Shantou	3
Yingde	5	Foshan	2
Qingyuan	4	Jiangmen	3
Xianning	4	Zhanjiang	3
Chibi	5	Maoming	3
Shaoguan	3	Zhaoqing	4
Huangshi	4	Huizhou	3
Shiyan	4	Meizhou	5
Yichang	3	Shanwei	5
xiangyang	3	Heyuan	5
ezhou	5	Yangjiang	5
Jinmen	4	Dongguan	2
Xiaogan	4	Zhongshan	2
Jinzhou	4	Chaozhou	5
Huanggang	4	Jieyang	4
Suizhou	5	Yunfu	5

Appendix E： the Cities along Wuhan-Guangzhou HSR Line